

Embossing Machine Roller

This invention relates to an embossing machine roller and to a method of producing an embossing roller for a machine, in particular for embossing microcopic relief images such as holographic images.

Sheet material which is embossed and metallized is often used nowadays for decorative purposes such as wrapping paper, greetings cards or decals. The patterns used are often complex, and may contain microscopic relief images displaying diffraction or holographic effects. For economical production, the sheet material needs to be embossed in rolls of considerable width and then sub-divided as necessary. It has however always been a problem to manufacture the embossing roller to do this, since the surface of the roller must carry many images side-by-side in order to cover the full width of the sheet material.

Experience has shown that in some circumstances the embossing surface wears too easily in use, and in particular is very susceptible to damage to its surface by careless handling. A single contact with a sharp hard object could ruin an entire roller.

Accordingly, the present invention further proposes a method of producing an embossing machine roller, characterised in that it comprises the steps of generating a master roller carrying an overall relief image casting an intermediate mould around the master roller to form an inverted relief image, and using the

intermediate mould to form a cylindrical outer layer of a relatively soft resilient material on a solid mandrel.

5 The invention further proposes an embossing machine roller for sheet material, characterised in that it comprises a solid cylindrical mandrel having an outer layer of a relatively soft resilient material, the layer carrying a relief image which is to be embossed.

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The invention further proposes a method of embossing sheet material, characterised in that the material is softened by heating and a relief pattern is imparted to its surface by contact with an embossing roller
15 carrying said pattern on an outer surface of a relatively soft resilient material.

The relatively soft resilient material may for example be rubber, synthetic rubber, or various plastics
20 materials. It must be unaffected by the temperature at which it is used to emboss the sheet material. The relief pattern may be a holographic image produced first on a small nickel shim by methods well known in the art.

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The master roller is preferably produced by the repetitive rolling method now to be mentioned but not necessarily so. Any method which produces a
sufficiently accurate master is acceptable.

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It has been known to prepare rollers by making an appropriate number of nickel shim images from a single photo-resist master of a laser generated image or any other desired complex profile. The shims are then

curved and stuck side-by-side in columns and rows on the outside of the roller. This has many difficulties and disadvantages. It takes a long time to produce shims; they are difficult to align, particularly when they must abut exactly to produce a continuous pattern; they tend to come unstuck in high speed use; and it is seldom possible to eliminate the witness lines (dividing lines) in a continuous pattern.

10 The present invention proposes a method of making an embossing machine roller, characterised in that it comprises the steps of rolling a blank roller having a metal outer surface against a harder metal die, carrying a desired relief image, under sufficient
15 pressure to emboss the image on the roller, the die having an area which is a fraction of the area of the roller outer surface, indexing the roller and/or the die, and repeating the rolling operation until the desired number of images or apparent overall image
20 appear on the roller.

Preferably, the roller is supported to prevent distortion during the rolling operation diametrically opposite to the die. The support may come from another
25 die so that two images are embossed at once on the roller surface.

The image on the roller surface is extremely accurate and the witness lines are eliminated.

30 Finally, the invention proposes a method of producing an embossing machine roller characterised in that it comprises the steps of: forming an adhesive layer on a mandrel, depositing a layer of granular material onto

th adhesive layer to form a master roller, casting an intermediate mould around the master roller, and using the intermediate mould to form a cylindrical outer layer of relatively soft resilient material on a solid,
5 further mandrel.

Suitable granular materials are talc, sand, comminuted plastic chips, or chips of sheet material which have been embossed with a refractive or holographic
10 reflective image.

The mandrel may be an already prepared embossing master roller, carrying microscopic relief images which are particularly covered by the granular material.
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In order that the invention shall be clearly understood, an exemplary embodiment will now be described with reference to the accompanying drawing, in which:
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Fig. 1 shows apparatus for producing a master roller.

Fig. 2 shows the first stage of producing an embossing roller;
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Fig. 3 shows the second stage; and

Fig. 4 shows the completed embossing roller.

30 The apparatus has a rigid frame 10 which supports a roller 11 which is to be embossed with a repeated pattern, for example a microscopic relief image, for future use as a master roller. The roller 11 is mounted for rotation in bearings 12. Two other

bearings 13,14 are positioned on diametrically opposite sides of roller 11 and support rotatable, cylindrical arcs 15,16. These arcs have a radius which is the same as that of the roller 11, and carry on their surface nickel shims 17 which carry a relief image which may be produced by any suitable means, for example by engraving, or etching, or electro forming. The dimensions of each shim 17 may be small relative to the dimensions of the roller: for example, one sixth of the roller circumference in height, by one twentieth of the roller length in width.

Means, not illustrated, are provided for rotating the roller 11 and the arcs 15,16 in unison in the directions of the arrows while maintaining contact between them at diametrically opposed axial lines on the circumference of the roller. The dimensions are accurately controlled so that for the duration of these rolling contacts the pressure between the contacting surfaces is of the order of many tons/square centimetre. Since the nickel shims are harder than the outer surface of the roller 11, the relief images are impressed in the outer surface. A single rolling impression is used, so that there is no danger of degradation of the impression by poor registration. The frame 10 is of a massive construction so that even the forces arising between the rolling members can lead to no distortion. The arcs 15,16 acting on opposite sides of the roller 11 ensure that the roller does not bend when the impression is effected midway along its length.

In addition to rotation, there is also provision for indexing of either the roller 11 or the arcs 15,16 in

unison, both so that different arcs of the circumference of the roller, and different sections along its length, can be embossed. Thus, with shims of the size mentioned above, the full circumference of the roller can be embossed by accurately indexing the roller twice after the initial impression so that successive 60° arcs are embossed.

Indexing is in each case by 60° in the direction of the arrow. Alternatively, the arcs 15,16 can be indexed back 60° to their starting position each time. This procedure is then repeated twenty times along the length of the roller. Again either the roller or the arcs can be moved.

The roller 11 might be of aluminium, with its outer surface very highly polished. Alternatively, a steel core may be used with a copper intermediate layer and a highly polished tin outer surface layer. The latter has the advantage of being non-corroding, particularly non-oxidisable, so that neither the embossed pattern nor the polished surface become degraded. In a modification the arcs may be rollers.

When a master roller has been prepared as described it will be found that a perfectly precise and uniform relief decoration will have been applied. However, the surface of the cylinder being a soft metal, it is not durable enough for embossing purposes, and the processes now described are required to produce a substantial and durable embossing roller. Refer to Figures 2 and 4.

First, a sleeve 20 of metal or other suitable material which has internal dimensions greater than the external dimensions of the master roller 21 is placed over the original.

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The void 23 between the master and the sleeve is then filled with silicone casting rubber or an alternative suitable casting material. When the casting material has set and cured, the master roller 21 can be extracted from the sleeve and casting material by cooling the master and/or heating the sleeve 20. If heating the sleeve is the option chosen, then it must be ensured that the casting material adheres to the sleeve 20, by application of a primer, but not to the master 21.

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Once the master roller has been removed, the inner surface 25 of the casting material 24 will display a perfect replication of the relief decoration 22 on the master.

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Second a mandrel 26 which will form the basis of the final embossing roller can now be inserted within and the casting material 24, and the sleeve 20 still attached to it. The mandrel must be smaller in external diameter than the internal diameter of the casting material 24, thereby creating a void 27.

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A suitable heat resistant relatively soft resilient material, such as casting resin or casting rubber, which can be made to adhere to the mandrel 26 but which has no natural adhesion to the casting material 24, can now be inserted between the mandrel 26 and original casting material. When the second casting material has

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hardened and cured, the mandrel with its externally cast layer 28 can be removed from the sleeve 20 with its internally cast layer 24.

- 5 Removal can best be achieved by driving a lubricant between the two cast layers under pressure. Having injected the lubricant in this fashion, it will be found relatively easy to remove the mandrel with its external casting layer. It will be seen, if correct materials are chosen, that the casting layer 28 applied to the mandrel 26 displays an exact reproduction 29 of the master roller.

- 15 A holographic embossing roller produced by these means can be made to be extremely durable, show perfect registration, and exact replication of the original hologram concerned. Moreover, the embossing process carried out on a sheet material is greatly simplified and more efficient. Preferably, the embossing is carried out on a material which is softened by heating (at least at the surface being embossed). Even the relatively soft resilient material is then hard enough to emboss satisfactorily, but does not wear much in use, nor is it damaged easily. The hardness should be between 40 and 90 shore A, preferably about 70. Moreover, silicone rubber is the preferred material since it has to adhesion for the surfaces to be embossed.

- 30 An alternative method of producing a master roller is to take a mandrel formed from a suitable material, and coat the mandrel with an adhesive substance. A layer of granular material is then deposited on the adhesive layer by sprinkling the granular material

onto the mandrel, or by rolling the mandrel in the granular material. The coated mandrel forms a master roller which can be used to produce embossing machine rollers by the method described.

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Suitable granular materials are talc, sand, or comminuted plastic chips. A particularly attractive "glitter-finish" embossing roller is produced if the granular material consists of small chips of a sheet material which has already been embossed with a refractive or holographic reflective image.

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The method can be used to treat a master roller that has already been prepared by another method. The granular material can be deposited in stripes which obliterate the original pattern.

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Claims

1. A method of producing an embossing machine roller characterised in that it comprises the steps of:
5 generating a master roller carrying an overall relief image, then casting a hallow intermediate mould around the master roller to form an inverted relief image, removing the intermediate mould, and using the intermediate mould to form the outer surface of a
10 cylindrical outer layer of a relatively soft resilient material on a solid mandrel.
2. A method as claimed in claim 1 wherein the resilient material is casting resin or casting rubber.
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3. A method as claimed in claim 1 or 2 wherein for removing the intermediate mould the master roller is cooled and/or the intermediate mould is heated.
- 20 4. A method as claimed in claim 1, 2 or 3 wherein the cylindrical outer layer on its mandrel is removed from the hallow intermediate mould by injection lubricant between the two.
- 25 5. An embossing machine roller for sheet material characterised in that it comprises a solid cylindrical mandrel having an outer layer of a relatively soft resilient material, the layer carrying a relief image which is to be embossed.

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6. A method of making an embossing machine roller, characterised in that it comprises the steps of rolling a blank roller (11) having a metal outer surface against a harder metal die (17), carrying a
5 desired relief image, under sufficient pressure to emboss the image on the roller, the die having an area which is a fraction of the area of the roller outer surface, indexing the roller and/or the die, and repeating the rolling operation until the desired
10 number of images or apparent overall image appear on the roller.

7. A method of making an embossing machine roller according to claim 6, wherein the roller (11) is
15 supported to prevent distortion during the rolling operation diametrically opposite to the die (17).

8. A method of making an embossing machine roller according to claim 7, wherein the support comes from
20 another die (17) so that two images are embossed at once on the roller surface.

9. A method of making an embossing machine roller according to any of claims, 6 to 8 wherein the blank
25 roller (11) rotates around its central axis (12) and the die (17) or dies are each pivotable and have an arcuate surface which embosses the blank roller.

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10. A method of making an embossing machine roller according to claim 9 when appended to claim 3, wherein each die (17) has an arcuate surface having a length of 1/6 of the circumference of the roller (11), and the indexing is by 60°.

11. A method of embossing sheet material, characterised in that the material is softened by heating and a relief pattern is imparted to its surface by contact with an embossing machine roller carrying said pattern on an outer surface of a relatively soft resilient material.

12. A method of embossing sheet material according to claim 11, wherein the relatively soft resilient material is a rubber or plastics material.

13. A method of embossing sheet material according to claims 11 or 12, wherein the relief pattern is a holographic image.

14. A method of producing an embossing machine roller characterised in that it comprises the steps of: forming an adhesive layer on a mandrel, depositing a layer of granular material onto the adhesive layer to form a master roller, casting an intermediate mould around the master roller, and using the intermediate mould to form a cylindrical outer layer of relatively soft material on a solid, further mandrel.

15. A method of producing an embossing machine roller according to claim 14, wherein the granular material comprises one or more of the following:

- 5 (i) Talc
 (ii) Sand
 (iii) Comminuted plastic chips
 (iv) chips of sheet material which have been
10 embossed with a refractive or holographic
 image.

16. A method of producing an embossing machine roller according to claims 14 or 15, wherein the mandrel comprises an embossing master roller.

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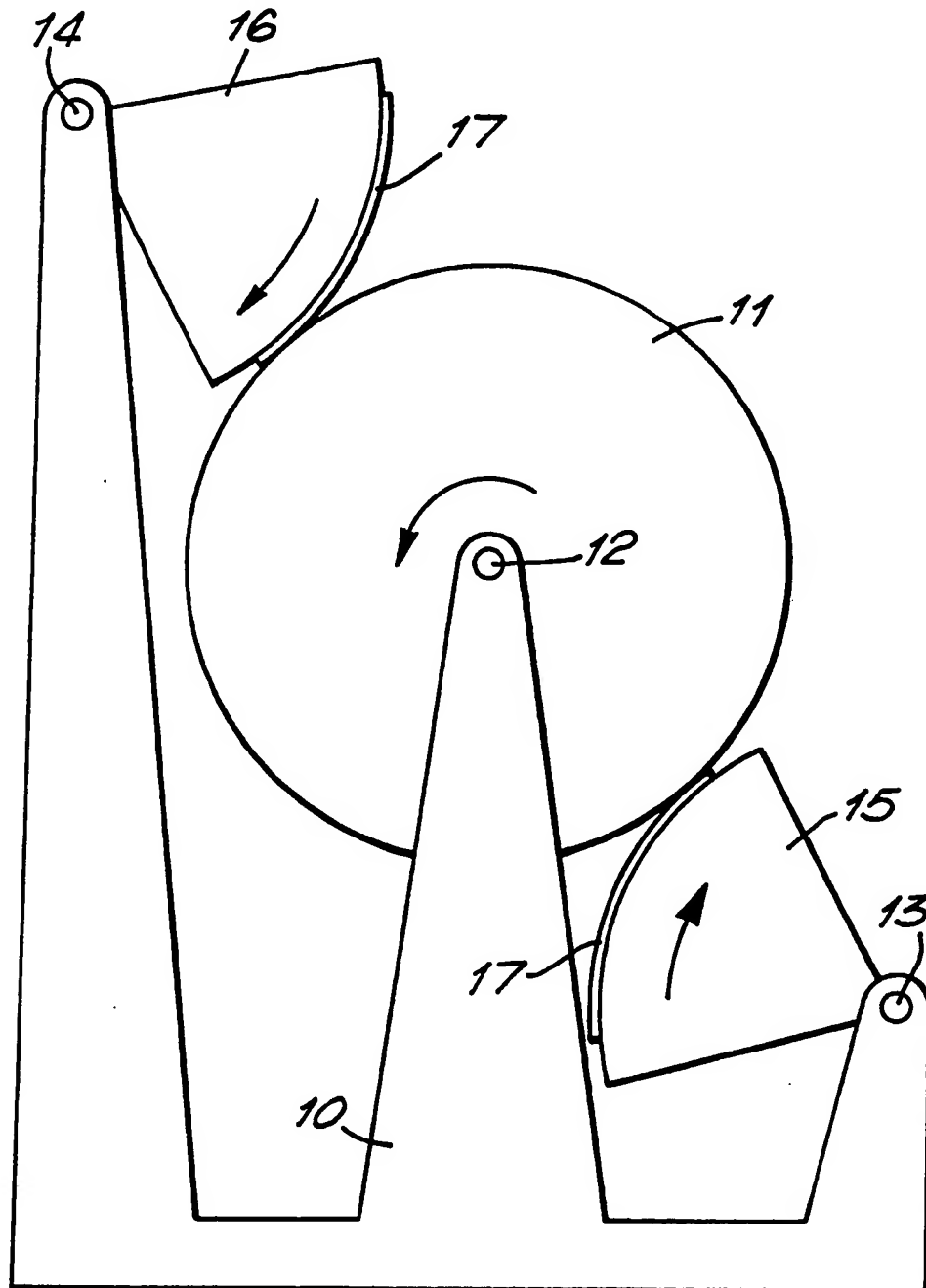


FIG. 1.

SUBSTITUTE SHEET

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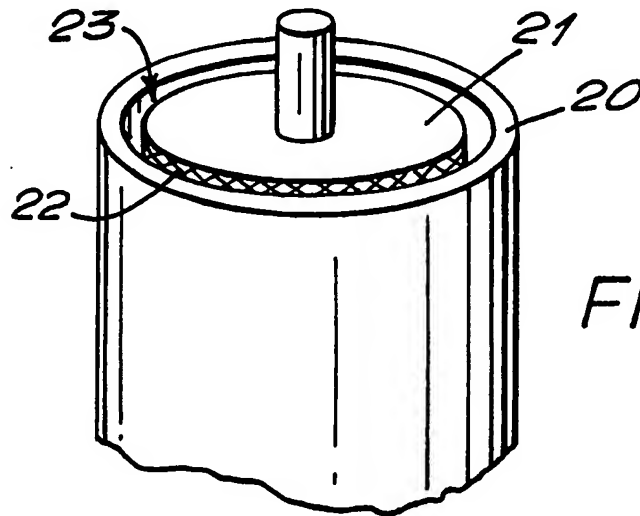


FIG. 2.

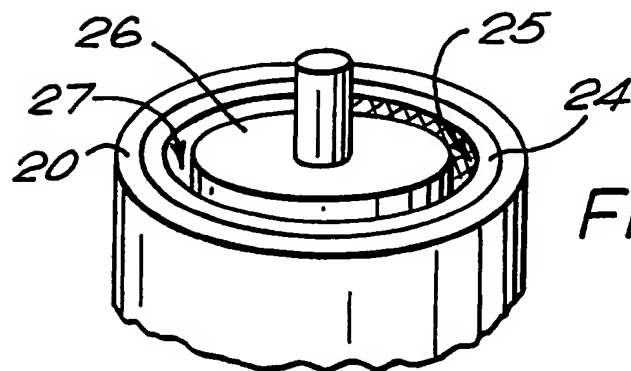


FIG. 3.

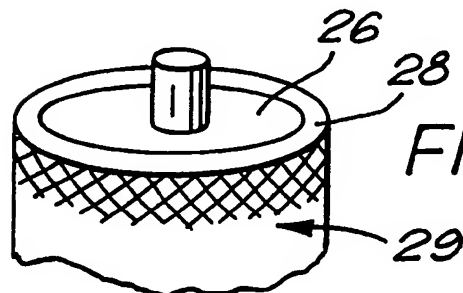


FIG. 4.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01111

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ¹		
According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁵ : B 44 B 5/02, B 44 B 5/00, G 03 H 1/02, G 03 H 1/04, B 29 C 59/04, B 21 H 7/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁵	B 44 B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US, A, 3619446 (J.P. NAUTA) 9 November 1971 see the whole document --	1-5
X	GB, A, 1139757 (KLEINWEFERS GRAVUREN GmbH) 15 January 1969 see page 4, lines 4-83; figures 6-11 --	1-5
X	US, A, 3893795 (J.P. NAUTA) 8 July 1975 see the whole document, in particular the abstract; column 4, lines 35-46; figures 5,6 --	5,11-13
A	WO, A, 89/03760 (DENNISON MANUFACTURING CO.) 5 May 1989 see the abstract -----	11,13
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>¹⁴ Special categories of cited documents: ¹⁵</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 50%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
23rd October 1990	17 JAN 1991	
International Searching Authority	Signature of Authorised Officer	
EUROPEAN PATENT OFFICE	MISS T. TAZELAAR	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(e).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This international Searching Authority found multiple inventions in this international application as follows:

1. Claims 1-5, 11-13
2. Claims 6-10
3. Claims 14-16

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
1-5, 11-13
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 9001111
SA 38615

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 14/01/91
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3619446	09-11-71	DE-A, B, C 1905198 FR-A- 2001236 GB-A- 1263272	21-08-69 26-09-69 09-02-72
GB-A- 1139757		None	
US-A- 3893795	08-07-75	DE-A, B, C 2141613 DE-A, C 2166679 FR-A, B 2103409 GB-A- 1327181 JP-A, B, C 52017568 US-A- 3839514 US-A- 3751550	16-03-72 15-05-75 14-04-72 15-08-73 09-02-77 01-10-74 07-08-73
WO-A- 8903760	05-05-89	AU-A- 2610988 EP-A- 0339079 US-A- 4913858	23-05-89 02-11-89 03-04-90